DEPARTMENT OF TRANSPORTATION
AND ENVIRONMENTAL SERVICES
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December 30, 2004

Mr. Ken McBee
Environmental Technical Services Administrator
VA Department of Environmental Quality
P.O. Box 10009
Richmond, Virginia 23240

Re: City of Alexandria Comments on the Downwash Modeling Study Protocols

Dear Mr. McBee:

Thank you for attending several public meetings in the City regarding issues related to the Downwash Modeling Study of emissions from the Potomac Power Generating Station. Your interest and efforts in listening to the concerns of Alexandria Citizens directly is much appreciated. This letter is in response to the request for comments concerning the proposed protocols for the Downwash Modeling Study required by the Virginia Department of Environmental Quality (VADEQ) of Mirant Potomac Power Generating Station to evaluate impacts of its emissions on the ambient air quality in the immediate neighborhood and the City of Alexandria.

The stated purpose of the Order by Consent is to ensure compliance with the ambient air quality standards regulated by 9 VAC 5 Chapter 30. Additionally, as represented by VADEQ to the City of Alexandria at Mirant Community Monitoring Group meeting and various other meetings, VADEQ will be modeling and evaluating for all Hazardous Pollutant emissions and impacts according to 9 VAC 5 Chapter 60 Part 200.

As you already know the City has serious concerns regarding the deficiencies in the proposed protocols. Attachment I provides a comprehensive set of the City comments. The City has spent a significant effort to develop recommendations for developing recommendations for approach for modeling PM2.5 impacts from the Potomac River Generating Station. These recommendations can be found in the Attachment II.

The City, based on additional input from the Citizens, has identified and provided to you a list of discrete points/addresses (Attachment III) that is identified as sensitive receptors because of their use or height. The City requests VADEQ to add these discrete points as receptors for modeling purposes, in addition to the defined grid.

The City appreciates the opportunity to submit these comments and will appreciate the ability to comment on the revised protocols as well. If there are any questions concerning these comments, please contact William Skrabak, Chief, Division of Environmental Quality, at 703-838-4334.

Sincerely,

Richard Baier, P.E., Director, T&ES

Attachments

cc: The Honorable Mayor, Vice Mayor and Members of the City Council
Philip Sunderland, City Manager
Ignacio Pessoa, City Attorney
Robert Burnley, Director, VDEQ
Jeffery A. Steers, Regional Director, NRO, VDEQ
Members of the Mirant Community Monitoring Group

ATTACHMENT I

Comments on Proposed Methodology for Modeling Impacts of Mirant's Potomac River Generating Station

Introduction

By the terms of the Order by Consent issued to Mirant Potomac River, LLC by Commonwealth of Virginia Department of Environmental Quality (VADEQ), Mirant is required to perform a refined modeling analysis to determine the Potomac River Generating Station's (PRGS's) impacts on ambient concentrations of criteria pollutants. The Order by Consent requires that the methodology for this analysis be described within a protocol that is approved by VADEQ prior to the commencement of the modeling.

VADEQ allowed the City of Alexandria the opportunity to review and comment on Mirant's modeling protocol. This document comprises the City of Alexandria's comments on Mirant's modeling protocol; the City's motivation in commenting is to ensure that the product of the modeling analysis is a comprehensive and accurate assessment of PRGS's impacts on the full range of pollutants for which health-based air quality standards and guidelines exist. These areas where the City feels that the proposed modeling methodology is deficient are more fully discussed below; remedial methodology is iterated at the close of the text.

However, to summarize, the most significant areas of deficiencies within Mirant's proposed methodology are:

1) the lack of receptor placement on all high-rise towers located within the immediate area of PRGS, i.e., within approximately ten blocks
2) no consideration of downwash and wake effects from the closely-located Marina Towers;
3) a receptor grid that extends far short of the significant impact area for the facility and does not include flagpole receptors at nearby raised residential structures;
4) no consideration of criteria pollutant impacts on offsite receptors by fugitive sources of particulate matter (PM10 and PM2.5) in the coal and ash yards;
5) no consideration of nearby interacting sources that also have an impact within the significant impact area of PRGS;
6) definition of site characteristics within the AERMOD model that are not consistent with the PRGS location;
7) the very limited scope of pollutants included within the analysis, currently excluding from consideration the criteria pollutant of PM2.5 and many toxic pollutants emitted by bituminous coal combustion and regulated by US EPA and VADEQ. This scope of pollutants must be expanded to include each of the speciated compounds of dioxins and furans, poly-nuclear aromatic hydrocarbons, organic compounds, acid gases, and trace metals as these are listed in Tables 1.1-12, 1.1-13, 1.1-14, 1.1-15 and 1.1-18, respectively

within US EPA's Compilation of Air Pollutant Factors[1] for bituminous coal combustion.[2] This list is also included in Attachment I (a).

Model Selection and Procedures

Within its protocol ("Protocol for Modeling the Effects of Downwash from Mirant's Potomac River Power Plant," ENSR Corporation, October 2004) that responds to the Order by Consent issued to Mirant (State Air Pollution Control Board to Mirant Potomac River, LLC, Registration No. 70228), ENSR has selected the model AERMOD to calculate impacts by the facility. ENSR correctly recognizes that the PRIME downwash algorithm is an important procedure to include for this analysis, where cavity and downwash effects dominate at close-in receptors. Although AERMOD is not yet approved as a US-EPA guideline model, correspondence on behalf of the City of Alexandria with US EPA Headquarters and Region III modeling contacts indicate that AERMOD's lack of approval as a guideline model does not in any way relate to the model's operational reliability,[3] and that the model (specifically AERMOD 02222, the version with PRIME) performs better than or comparably with ISCST3 (with PRIME) when evaluated against observed concentrations.[4] However, because AERMOD is not yet an approved guideline model, ENSR should obtain, and present within its report, documentation of approval by the US EPA Region III or VADEQ of their intent to apply AERMOD (with PRIME) for this application.

Although the Order by Consent issued by DEQ to Mirant Potomac River LLC does not explicitly include PM2.5 within its agreement and order, the stated purpose of the Order by Consent is to ensure compliance with ambient air quality standards regulated by 9 VAC Chapter 30.[5] Ambient air quality standards comprising 9 VAC Chapter 30 include PM2.5. Therefore, PM2.5 should be included within the modeling analysis that the Order by Consent mandates.

ENSR should apply a model that calculates both primary and secondary components of PM2.5 in the immediate region and at all receptors within PRGS's significant impact area for PM2.5. Attachment A includes an approach for modeling PM2.5 impacts by PRGS that calculates primary and secondary components of PM2.5 while retaining the important features of simulating wake and cavity effects and impacts by the coal and ash yard processes. The City asks that it be included within any discussion between Mirant and regulatory personnel regarding any deviation from or refinement to this recommended approach.

Any demonstration of attainment of standards using modeling results must satisfy criteria defined by both DEQ within 9 VAC 5 Ch. 30 and US EPA. In addition to its

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[1] "Compilation of Air Pollutant Emission Factors, AP-42," Fifth Edition, Volume 1, Stationary Point and Area Sources, US EPA.

[2] It is the City's understanding that impacts for all of the toxic pollutants emitted by PRGS will be estimated through modeling results; if in the case that Mirant does not provide these results then VADEQ has agreed to do so.

[3] Correspondence with Warren Peters, US EPA Headquarters and Denis Lohman, US EPA Region III, Nov. 10, 2004.

[4] "AERMOD: Latest Features and Evaluations Results," EPA-454/R-03-003, June, 2003.

[5] 9 VAC 5, Chapter 30. Ambient Air Quality Standards, Commonwealth of Virginia, State Air Pollution Board, Regulations for the Control and Abatement of Air Pollution.

designation as a nonattainment area for ozone, Alexandria County is a designated nonattainment area for PM2.5.[6] Therefore, compliance with the NAAQS for PM2.5 requires that Mirant demonstrate that PRGS's impacts of PM2.5 fall below the significance level.

Emission Estimates

ENSR's emissions err on the side of under-prediction for SO2, PM10 and PM2.5 and mercury. Table 1 provides emission estimates for each of these criteria pollutants that reflect the maximum potential of the facility's units. Generally, emission estimates proposed by ENSR err in 1) not assuming the maximum allowed fuel sulfur content nor accounting for the short-term variation in heat input among supplies of bituminous coal; 2) not delineating particulate emissions into categories less than 10 microns and less than 2.5 microns; 3) not including the very significant condensable portion of particulate matter in the estimate (condensable species will likely have sufficient time to cool to the particulate stage between their release and the time of their impact at ground level within the grid boundaries), and 4) relying on a Mirant-derived estimate for mercury emissions that is not supported by the facility's own test data or by other test data for bituminous coal-fired boilers controlled with hot- and cold-side electrostatic precipitators (ESPs), for which control of mercury is limited to approximately 45%.[7]

Mercury emission estimates for the purpose of demonstrating compliance with the short-term criteria of VA DEQ and US EPA Reference Concentrations should derive from at least three tests, separated by significant periods of time, to account for the variability in mercury content within strains of bituminous coal that are fired at the facility. Additionally, results should be scaled upward to account for any load level less than maximum heat input at the time of the test, if maximum load is shown to be the worst-case load (see Load Analysis below). In lieu of using facility-derived comprehensive test data for emission estimates of mercury, ENSR should use comprehensive test results, derived using EPA-approved test methods from other bituminous coal-fired facilities fitted with both cold-side and hot-side ESPs.[8]

Note that by using test results for mercury that are representative of average or low mercury content within the coal, PRGS will constrain itself to a permit limit for mercury emissions that is either impossible or difficult to meet on a continual basis. This is true for all criteria pollutants; emission values used within the modeling analysis will become federally-enforceable permit terms to which the facility's operation is constrained.[9]

ENSR proposes apportioning mercury emissions evenly among stacks. This procedure should be replaced with an apportionment of mercury emissions, as should

[6] US EPA, "Fine Particle (PM2.5) Designations, Dec. 20, 2004, www.epa.gov/pmdesignations/finaltable.htm.
[7] Table 1, Background Document and Technical Support for Public Hearings on Proposed Amendments to 310 CRM 7.00 et seq.: 310 CMR 310 CMR 7.29 "Emission Standards for Power Plants," October, 2003.
[8] Ibid.
[9] Compliance with National Ambient Air Quality Standards will become an enforceable permit term within the PRGS's Title V permit.

be done for emissions of all pollutants, based on each boiler's potential heat input and any other boiler-specific and stack-specific characteristics. Test results for all boilers should be publicly disclosed to allow confirmation of each assumed boiler and stack characteristic within the modeling analysis.

Table 1. Selected Criteria Pollutants and Mercury: Short-term Emissions (grams/second or as noted).

Boiler Unit	SO2	PM10	PM2.5	Mercury
1	226.	12.2	10.5	4.31 E-05 lb/MMBtu
2	226.	12.2	10.5	4.31 E-05 lb/MMBtu
3	224	12.0	10.4	4.31 E-05 lb/MMBtu
4	224	12.0	10.4	4.31 E-05 lb/MMBtu
5	224.	12.0	10.4	4.31 E-05 lb/MMBtu
Basis:	Boiler ratings and maximum fuel sulfur percent allowed.	AP-42, using facility's historical records of coal % ash;, both values also include the condensable portion of PM.[10]		Mercury stack tests from similarly-controlled facility combusting bituminous coal.[11]

Estimates of PM10 and PM2.5 impacts should also include the contribution by emissions from each of the coal and ash handling processes at the facility. Table 2 lists these processes. This table is not intended to exclude from the modeling evaluation any other coal and ash handling process that exists at the facility. AERMOD and CALPUFF have the capability to simulate these processes as volume, line, area or point sources[12] depending on how the process is best represented. Without these estimates of PM10 and PM2.5 impacts for the facility a demonstration of ambient air quality impacts by the facility is incomplete. Impacts from these types of processes can exacerbate compliance demonstrations at fenceline and close-in receptors because dispersion of their emissions is characterized by low momentum and buoyancy fluxes and by ground-level release.

Table 2. Coal and Ash Handling Processes for which PM10 and PM2.5 Emissions must be Calculated and included within Modeling Analysis.	
Coal Handling	**Ash Handling**
Coal Transport by Rail Car on	Silo Ventilation

[10] Uses fuel ash and heat content per delivery records for facility in period of January through June 2004. See Tables 1.1-5 and 1.1-6 of AP-42 for emission factors.

[11] See Chart 3 of "Background Document and Technical Support for Public Hearings on Proposed Amendments to 310 CMR 7.00 et seq., 310 CMR 7.29 "Emission Standards for Power Plants," Bureau of Waste Prevention, Division of Planning and Evaluation, October, 2003. Brayton Point shows a maximum value of 2.0 micrograms per dry standard cubic foot.

[12] "Revised Draft, User's Guide for the AMS/EPA Regulatory Model – AERMOD," US EPA, August, 2002.

Site (uncovered)	
Coal Tipping Facility	Roadway Emissions from Truck Travel
Coal Crushing	Fly Ash Escaping from Loaded Trucks
Coal Pile Loading	Fly Ash Released from Empty Trucks
Coal Pile Wind Erosion	
Coal Pile Loading	
Coal Breaker House Emissions	
Silo Ventilation	

ENSR's proposal for assessing compliance with the 24-hour PM10 standard does not satisfy the compliance definition for PM10 under VADEQ regulation; criteria for attainment include a demonstration that the expected number of days per calendar year with a 24-hour average concentration above 150 micrograms per cubic meter is equal to or less than one. Similarly, the annual PM10 criteria set by VADEQ requires that the modeling analysis show compliance on the basis of impacts within a single year; the standard is attained when the expected annual arithmetic mean concentration is less than or equal to 50 micrograms per cubic meter. The PM10 short-term and annual modeling results must also use these more stringent VADEQ criteria versus the criteria proposed by ENSR.[13]

The analysis currently excludes from consideration the great number of toxic pollutants emitted by bituminous coal combustion and regulated by US EPA and VA DEQ. The pollutants for which impacts must be determined through modeling include each of the speciated compounds of dioxins and furans, poly-nuclear aromatic hydrocarbons, organic compounds, acid gases, and trace metals (excepting mercury, for which emissions should be derived as discussed above) as these are listed in Tables 1.1-12, 1.1-13, 1.1-14, 1.1-15 and 1.1-18, respectively within US EPA's Compilation of Air Pollutant Factors[14] for bituminous coal combustion. The modeling analysis should evaluate impacts against both guideline values developed using Virginia Administrative Code[15] and the more protective and peer-reviewed US EPA Integrated Risk Information System (IRIS) criteria and thresholds for chronic inhalation exposure and cancer risk, when these are defined. IRIS values are considered more protective for this assessment because they are developed using chronic exposure observational data, while VADEQ's Standards for Performance derive from worker-based (8-hour) Threshold Limit Values[16] developed for use in occupational settings. Short-term impacts of all potential pollutants should be evaluated using the maximum heat input rating of the boilers.

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[13] Commonwealth of Virginia, State Air Pollution Control Board, Regulations for the Control and Abatement of Air Pollution, 9 VAC 5 Chapter 30. Ambient Air Quality Standards.
[14] "Compilation of Air Pollutant Emission Factors, AP-42," Fifth Edition, Volume 1, Stationary Point and Area Sources, US EPA, Section 1.1 Bituminous and Subbituminous Coal Combustion, September 1998.
[15] 9 VAC5-60-230; Significant ambient air concentration guidelines.
[16] 2001 TLVs and BEI's, Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices, ACGIH Worldwide,

Load Analysis

Within AERMOD, the worst-case load, or load that causes maximum concentrations among receptors should be established by simulating the maximum and minimum capacity as well as one intermediate load that is representative of actual facility operations.

Stack Parameters

The protocol's Table 2-1 shows a stack diameter that may be too small; visual inspection indicates a stack diameter of approximately 15 feet. Also, stack gas velocities are reported to be 26 meters per second versus the 30.2 to 35.7 meters per second values that ENSR proposes using.[17] An underestimation of stack diameter, and an overestimation of velocity, will lead to greater momentum and plume dispersion than actually occurs. ENSR relies on the results of a stack test to determine carbon monoxide emissions; to iterate, this and any test report should be made available for public inspection to ensure that stack parameters within the proposed modeling analysis are consistent with test results (scaled to represent worst-case conditions where appropriate). Additionally, while the base elevation of the stack is shown at 10.4 meters, this elevation applies to all buildings on site, to surrounding structures, and to all fenceline receptors.

Background Concentrations

Page 4 of the Order by Consent indicates that the modeling analysis should determine the degree to which the facility may contribute to exceedances of the NAAQS or Standards for Performance. Therefore, impacts by other nearby sources in the area are a necessary component of this modeling analysis. Although ENSR proposes adding the facility's impact to ambient concentrations measured by DEQ for each of CO, NOx, SO2 and PM10, these measured ambient concentrations are generally considered to represent the portion of background air quality attributable to natural, minor and distant major sources. ENSR should determine for the facility the significant impact area of each of the criteria pollutants (as defined by US EPA's guidelines, for example, see Table C-4 in New Source Review Workshop Manual, US EPA, October, 1990), and, in accordance with the US EPA's Guideline on Air Quality Models (see 9.2 Background Concentrations and 9,2.3 Recommendations (Multisource Areas)), include sources within the analysis that will also have a significant impact on receptors within the properly-defined grid (see Terrain and Receptor Data, below).

GEP Analysis

ENSR uses a value for boiler building height that is lower than the reported value. The boiler building is reported equal to 125 feet (38 meters) versus the 35.3 meter

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[17] Washington Post, Pepco Dedicates Huge Power Plant in Alexandria," Oct. 8, 1949.

height that ENSR uses.[18] The reported height of the stack is equal to 48.8 versus the 49.1 meter height that ENSR proposes. [19]

ENSR does not include Marina Towers within the GEP calculation or downwash analysis. This structure, with height and maximum projected width equal to approximately 150 and 200 feet respectively, is close enough at a distance of approximately 300 feet, to influence the wake of the PRGS. Marina Towers' dimensions and layout should be defined within the Building Profile Input Program (BPIP) program so that its influence can be accounted for within the modeling analysis.

Tables 3-1 and 3-2 within the protocol indicate that the boiler stacks are not affected by downwash from either of silos 1,2 or 3. However, visual inspection shows that the each of the silos is close enough to the boiler building that the silos' and building's wakes interact. In this case, for wind directions where the projected width of the boiler building does not overlay that of the silo, the distance between the silo and building should be filled according to US EPA downwash guidance.[20] Therefore, Table 3-2 should instead indicate that the stacks are potentially affected by downwash from the silos, and the silos should be included in the BPIP analysis.

Receptor Data

Flagpole receptors should be placed at heights and locations representative of each of the outside patios at Marina Towers, for example, at least in an array with receptors placed in the vertical direction approximately every 8 to 10 feet from ground level to roof height, along vertical lines placed approximately every 30 feet in the horizontal direction (at locations representative of the residences) extending from the east to west side of the building. Impacts at other raised residential structures in the immediate area should also be evaluated by placement of flagpole receptors at levels and locations consistent with each balcony. These residential structures will be indicated with their addresses within an attachment that will be relayed to DEQ at a later date. Locations consistent with sensitive receptors should also be defined as discrete receptors within the modeling grid. These locations will also be defined within that later attachment. Note that City GIS[21] data can be accessed by ENSR to assist in determining any corresponding locations on the modeling grid.

CH2MHill in a report presented to Mirant in 2001 states that "modeling results for boiler stack emissions predict maximum impacts from fly ash will occur north of the plant about 2 to 3 kilometers downwind" and "that predicted maximum concentrations in the immediate neighborhood are less than 0.1 percent of the maximum predicted concentration."[22]

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[18] Washington Post, "Pepco Dedicates Huge Power Plant in Alexandria," Oct. 8, 1949.
[19] Washington Post, "Making Power on the Potomac Consumes Coal by the Carload," Dec. 15, 1983.
[20] "User's guide to the Building Profile Input Program," US EPA, October, 1993.
[21] GIS Data CD; The City of Alexandria, Spring 2004.
[22] "Fugitive Dust Review," CH2MHill to Mirant, July 20, 2001.

To iterate, the grid upon which receptors are placed within ENSR's modeling analysis should extend to each pollutant's respective significant impact area, versus the one- kilometer distance that ENSR proposes.

Site Characteristics

ENSR proposes defining land use sectors and characteristics based on Reagan National Airport as the center point versus PRGS. However, sector characteristics based on PRGS differ significantly from those defined based on Reagan National Airport; for example, flow from PRGS towards Marina Towers should show land-based characteristics, versus the water-based characteristics that derive from a sector centered on Reagan National Airport. Also significant is the definition of the southerly sector: land use with PRGS as the center point reflects an urban classification for this sector versus the water classification for the airport. All land use characteristics and sectors should derive from consideration of PRGS as the center point, and the Auer method[23] should be used for apportionment guidance.

Remedial Action Items

1. ENSR should obtain, and present within its report, documentation of approval by the US EPA Region III or VADEQ of their intent to apply AERMOD (with PRIME) for the criteria pollutants of this analysis except PM2.5.
2. For PM2.5, ENSR should follow the approach recommended here within Attachment A. PRGS is located within a PM2.5 nonattainment area; therefore this NAAQS demonstration must show through modeling results that the facility's impacts of PM2.5 do not exceed significance levels.
3. Emission rates should be revised to reflect the a) maximum allowed fuel sulfur content, b) minimum heat input among supplies of bituminous coal; c) delineation of particulate emissions into categories less than 10 microns and less than 2.5 microns; and d) the condensable portion of particulate matter.
4. Emission rates for mercury should be revised to reflect either the worst-case mercury emissions for bituminous coal-fired boilers controlled with hot- and cold-side electrostatic precipitators (ESPs), or the results of at least three tests at PRGS, separated by significant periods of time, to account for the variability in mercury content within strains of bituminous coal that are fired at the facility. All results should be scaled to account for worst-case load conditions.
5. Apportionment of emissions between boilers should be based on each boiler's potential heat input and any other boiler, load and stack-specific characteristics.
6. Through the application of AERMOD, the worst-case load, or load that causes maximum concentrations among receptors should be established by simulating the maximum and minimum capacity as well as one intermediate load representative for the facility. All results should be representative of this worst-case operating condition.

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[23] Auer, A., 1978 Correlation of Land-use and Cover with Meteorological Anomalies. Journal of Applied Meteorology, American Meteorological Society, Vol. 17, pp. 636-643.

7. All test reports from which load, stack and emission parameters are derived should be made available for public inspection.
8. Each of the coal and ash handling processes, listed but not limited to those in Table 2, should be defined with AERMOD and CALPUFF as volume, line or area sources. Control technologies proposed for these processes but not yet present should not be assumed within the analysis.
9. The PM10 short-term and annual modeling results must use all attainment criteria defined by VADEQ criteria, including the criteria defined for distinct single years.
10. The range of pollutants for which impacts are calculated should be expanded to included toxic pollutants as these are listed in Tables 1.1-12, 1.1-13, 1.1-14, 1.1-15 and 1.1-18, respectively within US EPA's Compilation of Air Pollutant Factors for bituminous coal combustion. The modeling analysis should evaluate impacts against both guideline values developed using Virginia Administrative Code and the more protective and peer-reviewed US EPA Integrated Risk Information System (IRIS) criteria. Short-term impacts of all potential pollutants should be evaluated using the worst-case load of the facility.
11. The grid upon which receptors are defined within ENSR's modeling analysis should extend to each pollutant's respective significant impact area, determined according to procedures outlined in US EPA's New Source Review Workshop Manual, US EPA, October, 1990 (see Table C-4).
12. In addition to adding background concentrations derived from measured ambient levels in the region, ENSR should include within AERMOD and CALPUFF simulations all interacting nearby sources that, in accordance with US EPA's Guideline on Air Quality Models (see 9.2 Background Concentrations and 9,2.3. Recommendations (Multisource Areas)), have a significant impact on receptors within the PRGS's significant impact area.
13. Marina Towers' dimensions and layout should be defined within the Building Profile Input Program (BPIP) program so that its influence can be accounted for within the modeling analysis.
14. For wind directions where the projected width of the boiler building does not overlay that of the silo, the distance between the silo and building should be filled according to US EPA downwash guidance.
15. Impacts at raised residential structures in the nearby area should be evaluated by placement of flagpole receptors at levels equivalent to all balconies and access points. These residential structures, and locations consistent with sensitive receptors are indicated with their addresses will be included within an attachment to be relayed at a later date.
16. All land use characteristics and sectors should derive from consideration of PRGS as the center point, and the Auer method should be used for apportionment guidance.

ATTACHMENT Ia

Pollutant listed in AP-42	Table within AP-42's Section 1.1:
Manganese	T. 1.1-18 Trace Metals
HCL	T. 1.1-15 HCl and HF
Arsenic	T. 1.1-18 Trace Metals
Mercury(1, highest bitu.)	T. 1.1-18 Trace Metals
Cadmium	T. 1.1-18 Trace Metals
HF	T. 1.1-15 HCl and HF
methyl hydrazine	T. 1.1-14-Organics
Lead	T. 1.1-18 Trace Metals
Chromium VI	T. 1.1-18 Trace Metals
Selenium	T. 1.1-18 Trace Metals
Cobalt	T. 1.1-18 Trace Metals
Mercury (EPA test)	T. 1.1-18 Trace Metals
Nickel	T. 1.1-18 Trace Metals
Beryllium	T. 1.1-18 Trace Metals
Chromium	T. 1.1-18 Trace Metals
acrolein	T. 1.1-14-Organics
formaldehyde	T. 1.1-14-Organics
benzyl chloride	T. 1.1-14-Organics
dimethyl sulfate	T. 1.1-14-Organics
benzene	T. 1.1-14-Organics
Antimony	T. 1.1-18 Trace Metals
2-chloroacetophenone	T. 1.1-14-Organics
isophorone	T. 1.1-14-Organics
bromoform	T. 1.1-14-Organics
acetaldehyde	T. 1.1-14-Organics
carbon disulfide	T. 1.1-14-Organics
2,4-dinitrotoluene	T. 1.1-14-Organics
biphenyl	T. 1.1-13-PAHs
toluene	T. 1.1-14-Organics
chloroform	T. 1.1-14-Organics
ethylene dichloride	T. 1.1-14-Organics
methyl chloride	T. 1.1-14-Organics
phenol	T. 1.1-14-Organics
methyl chloride	T. 1.1-14-Organics
chlorobenzene	T. 1.1-14-Organics
methyl bromide	T. 1.1-14-Organics
acetophenone	T. 1.1-14-Organics
methyl ethyl ketone	T. 1.1-14-Organics
ethyl chloride	T. 1.1-14-Organics
ethyl benzene	T. 1.1-14-Organics
styrene	T. 1.1-14-Organics
vinyl acetate	T. 1.1-14-Organics
tetrachloroethylene	T. 1.1-14-Organics
xylenes	T. 1.1-14-Organics
cumene	T. 1.1-14-Organics
methyl methacrylate	T. 1.1-14-Organics
hexane	T. 1.1-14-Organics
naphthalene	T. 1.1-13-PAHs
Other Coal tar pitch volatiles	T. 1.1-13-PAHs
Other PAHs: no CAS or syn.	T. 1.1-13-PAHs
Magnesium	T. 1.1-18 Trace Metals

2,3,7,8 TCDD	T. 1.1-12 PCDFs/PCDDs
Total PCDD	T. 1.1-12 PCDFs/PCDDs
2,3,7,8 TCDF	T. 1.1-12 PCDFs/PCDDs
Total PCDF	T. 1.1-12 PCDFs/PCDDs
bis(2-ethylhexyl)phthalate	T. 1.1-14-Organics
cyanide	T. 1.1-14-Organics
ethylene dibromide	T. 1.1-14-Organics
methyl tert butyl ether	T. 1.1-14-Organics
propionaldehyde	T. 1.1-14-Organics
1,1,1-trichloroethane	T. 1.1-14-Organics

Attachment II - Recommended Approach for Modeling PM2.5 Impacts from PRGS

Purpose of this Document

PRGS's contribution to ambient levels of particulate matter measuring less than 2.5 microns in diameter (PM2.5) in Alexandria was identified as an issue of particular significance by the City of Alexandria.[1] Alexandria County is a designated nonattainment area for PM2.5.[2] Although the Order by Consent issued by DEQ to Mirant Potomac River LLC does not explicitly include PM2.5 within its agreement and order, the stated purpose of the Order by Consent is to ensure compliance with ambient air quality standards regulated by 9 VAC Chapter 30. Ambient air quality standards comprising 9 VAC Chapter 30 include PM2.5. Therefore, within its comments on the proposed modeling methodology, the City is asking that PM2.5 be included within the modeling analysis that the Order by Consent mandates.

This document summarizes the approach that the City recommends for modeling PRGS's contribution to ambient levels of PM2.5 in Alexandria. For all criteria pollutants except PM2.5, guidance for determining if a single source complies with ambient air quality standards is defined within US EPA's Guideline on Air Quality Modeling (the Guideline); there currently exists no similar federal guidance for modeling PM2.5 impacts from a single source.[3] In accordance with the Guideline for situations where guidance is not explicit, the development of the approach recommended here was derived using the suggestions and comments of US EPA headquarters and Region III modeling contacts.[4] Additionally, this recommended approach relies on the conclusions of a previous PM2.5 modeling analysis that applied CALPUFF to the DC metropolitan region, the results of US EPA evaluation studies for CALPUFF and modeling documentation for CALPUFF and CMAQ. This approach includes the application of CALPUFF in a screening mode; this approach will allow for the calculation of secondary and primary components of PM2.5 at all receptors within PRGS's significant impact area, while retaining the very important features of simulating wake and cavity effects in the immediate region of the facility and including PM2.5 impacts from coal and ash yard processes.

Nature of PM2.5 in City of Alexandria and DC Metropolitan Region

A measurement of PM2.5 within the ambient air would include particulate composed of primary and secondary portions. The primary component is the portion that was released as a liquid or particle from a source; it includes emissions of elemental and organic carbon and dust. The secondary component includes gaseous phase species that through phase, photochemical and aqueous reactions with other components of the atmosphere develop into particulate matter. The particular gaseous species that are the most likely sources of the secondary portion of PM2.5 in the DC metropolitan region, i.e., that are precursors to PM2.5, are sulfates, nitrates and ammonium ions.[5] As a coal-fired combustor, the PRGS emits relatively high levels of these PM2.5 precursors. A recent source apportionment study shows that that over 50% of PM2.5 in

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[1] Memorandum, P. Sunderland, City Manager to Honorable Mayor and Members of City Council, November 7, 2003, City of Alexandria, Virginia.

[2] US EPA, "Fine Particle (PM2.5) Designations, Dec. 20, 2004, www.epa.gov/pmdesignations/finaltable.htm.

[3] 40 CFR Ch. 1 (7-1-03 Edition), Appendix W to Part 51 – Guideline on Air Quality Models; and correspondence with D. Lowman, US EPA Region III, Nov. 2004.

[4] Correspondence with W. Peters US EPA Headquarters and D. Lowman, US EPA Region III, Several dates, Nov. 2004.

[5] "Analysis of Particulate Matter Impacts for the City of Alexandria, Virginia," J. Levy, Harvard School of Public Health, April, 2004.

the DC metropolitan region derives from sulfates emitted from coal-fired combustion,[6] and the results of a study applying CALPUFF to power plant emissions indicate that secondary particulate matter contributes a large portion of the concentration/health impacts from air emissions at grandfathered coal plants.[7]

AERMOD's Calculations Limited to Primary Component

Federal guidance states that for areas where secondary PM2.5 concentrations are expected to be high, that models that integrate chemical and physical processes are important for determining the formation, decay and transport of the precursor species.[8] The modeling methodology for PRGS currently proposes using AERMOD to determine impacts of SO2, NOx, CO, Pb and PM10; the range of pollutants to which AERMOD is applied can easily be expanded to include the simulation of dispersion and impacts of the primary component of PM2.5. However, estimates produced by AERMOD will underestimate total PM2.5 impacts by PRGS because AERMOD does not have the capability to calculate the contribution to PM2.5 by the formation, decay and transport of gaseous phase compounds emitted by PRGS.

CALPUFF Calculates Secondary Component

Although CALPUFF is recommended explicitly within the Guideline for applications of long-range transport (50 to 200 kilometers) because of its ability to fully characterize the effect of stagnation, wind reversals, and time and space-varying meteorological conditions on dispersion,[9] a design purpose of CALPUFF includes determining secondary pollutant formation and particulate matter modeling.[10] The transformation pathways for sulfates, nitrates and ammonium nitrate are simulated within CALPUFF.[11] In caveat, CALPUFF's algorithms may not adequately account for the aqueous phase oxidation of sulfates; aqueous phase chemistry can dominate the formation of sulfate[12] leading to an underestimation of total sulfate impacts where CALPUFF is used.

However, the feature of CALPUFF allowing full meteorological characterization requires large expenditures of time and resources; in many applications like long-range transport, areas of extreme complex terrain, and where stagnation, inversion, re-circulation and fumigation conditions may dominate, full meteorological characterization is an important aspect of the model simulation. However, for this analysis, where the maximum impacts of primary PM2.5 and secondary PM2.5 attributable to PRGS's emissions occur within the range of ten kilometers[13] and where complex terrain is not the dominant terrain feature, it may be reasonable to assume that meteorological conditions are homogenous in the horizontal scale for time periods of one hour.

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[6] Draft, "Compilation of PM2.5 Source Apportionment Results," Battelle Industries, August 22, 2003.
[7] "Using CALPUFF to evaluate the impacts of power plant emissions in Illinois: model sensitivity and implications," J. Levy, Spengler, J.D., Hlinka, D., Sullivan, D., Moon, D., Atmospheric Environment, V. 36 (2002), pp. 1063-1075.
[8] (40 CFR Ch. 1; Appendix W to Part 51 – Guideline on Air Quality Models).
[9] Ibid.
[10] "EarthTech's Official Calpuff Website," CALPUFF Modeling System, www.src.com/calpuff.
[11] "Analyses of the CALMET/CALPUFF Modeling System in a Screening Mode," EPA-454/R-98-010, November, 1998.
[12] "Interagency Workgroup on Air Quality Modeling (IWAQM); Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts," US EPA, OAQPS, EPA-454/R-98-019, December, 1998.
[13] Levy, 2004.

CALPUFF in a Screening Mode

The performance of CALPUFF in applications without full characterization of meteorology was evaluated by US EPA. Results from a version of CALPUFF using steady-state meteorological input files, i.e., in a screening mode, were compared to results from CALPUFF using a fully-developed wind field, i.e., in a refined mode, for one year. For 24-hour and annual averaging periods for scenarios with 2-meter and 35-meter high sources, results of sulfate concentrations (requiring CALPUFF's chemical transformation capabilities) show that screening mode results are generally in close agreement with refined mode results. Very short-term results (one hour) showed less agreement; however, the standards for PM2.5 are defined only for 24-hour and annual periods.[14] Although this particular evaluation study did not include downwash within any of the scenarios, CALPUFF does include downwash and wake effects as modeling options.

Additionally, in a study comparing results of ISCST3 (currently recommended within the Guideline for analyses with features similar to this one) with CALPUFF, results indicate good agreement for conditions similar to this proposed modeling analysis, i.e., for results in the range of 10 kilometers or less, and for sources of low height (area source) and a 35-meter height (point source, as in a stack configuration).[15] This study indicates that CALPUFF includes design feature that make it suitable for calculating concentrations at shorter ranges.

To summarize, applying CALPUFF in a screening mode to determine PM2.5 impacts from PRGS would produce a result that includes both the primary and secondary components of PM2.5 while retaining the capability to simulate near- and far-field wake effects from the PRGS and Marina Tower structures. Additionally, running CALPUFF in a screening mode would yield results that are derived from a wind-field representation that is equivalent in resolution to that of AERMOD.[16] In caveat, there are presently no studies available to evaluate the comparison of CALPUFF in a screening mode with refined CALPUFF results for scenarios with downwash and wake effects.

CALPUFF Inputs Specific to this Analysis

For this scenario where PM10 deposition will not be simulated by AERMOD, the deposition of PM2.5 should similarly not be simulated. To assist with application in a screening mode, CALPUFF has a built-in mode allowing it to use meteorological data file generated for use in ISCST3 by the preprocessor PCRAMMET. CALPUFF's chemical transformation algorithms should be selected to include the conversion to nitric acid. In this case, background values of ozone and ammonia are necessary and can be determined using US EPA and DEQ ambient monitoring results; specification of ammonia that is consistent with actual background values in the Alexandria region will be important to the estimation of particulate nitrate concentrations.[17] For conversion of AERMOD's receptor grid to CALPUFF, a preprocessor to CALPUFF, ISC2PUF, can assist in converting a polar grid (not normally recognized by CALPUFF) to

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[14] "Analyses of the CALMET/CALPUFF Modeling System in a Screening Mode," EPA-454/R-98-010, November, 1998.

[15] "A Comparison of CALPUFF with ISC3," Office of Air Quality Planning and Standards, EPA-454/R-98-020, December, 1998.

[16] AERMOD is recommended as the model to apply to determine results for PM10 and other criteria pollutants for this analysis. In an evaluation of its performance with respect to observations, the performance of AERMOD for simulations where downwash is significant is on average equal to 97%.

[17] "Interagency Workgroup on Air Quality Modeling (IWAQM); Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts," US EPA, OAQPS, EPA-454/R-98-019, December, 1998.

discrete receptors. In this domain where receptors of particular interest are within very short range of the source, applying CALPUFF in a slug mode applied with default options will prevent the under-estimation of concentration at receptors that can occur when puffs are used.[18]

CMAQ Modeling System

The Community Multi-scale Air Quality (CMAQ) modeling system includes gas phase chemistry that supports the determination of suspended particulate formation from sulfate, nitrate, ammonium and organic precursors. One of CMAQ's strengths is that it is designed to efficiently depict aerosol dynamics that lead to the formation of the secondary component of PM2.5.[19] Although CMAQ may more accurately depict the dynamics leading to secondary PM2.5 formation, its application would require an expense of time and resources at least equivalent to that of CALPUFF in a refined mode. Therefore, for this analysis where the secondary component of PM2.5 attributable to PRGS's emissions may peak well beyond the extent of a receptor grid encompassing Alexandria,[20] the additional resolution that CMAQ offers is not likely warranted.

Conclusion

The proposed modeling methodology should include the calculation of PM2.5 impacts by PRGS using CALPUFF, allowing the calculation of the chemical transformation of sulfate, nitrate and nitric acid species. In caveat, CALPUFF may underestimate the portion of secondary PM2.5 contributed by aqueous phase sulfate transformation. For this analysis, where the assumption of a horizontally homogenous wind field within the domain of application is a reasonable assumption, application of CALPUFF in a screening mode is likely to show a similar result to that of CALPUFF in a refined mode.

[18] "A nalyses of the CALMET/CALPUFF Modeling System in a Screening Mode," EPA-454/R-98/010, November, 1998.
[19] "Science Algorithms of the EPA Models-3 Community Multiscale Air Quality (CMAQ) Modeling System," US EPA, Office of Research and Development, EPA/600/R-99/030, March, 1999.
[20] In "Analysis of Particulate Matter Impacts for the City of Alexandria, Virginia," J. Levy states that the maximum secondary PM2.5 concentration occurs approximately 12 kilometers from the PRGS.

Attachment III

Area of Interest	Physical Address	Comments	Use	# of Stories	# of Units
Alexandria House	498 Madison Street	multi-story building needs elevated receptors	Residence Building (Multi level)	22	208
Carlyle Towers	2121 Jamison Avenue	multi-story building needs elevated receptors	Residence Building (Multi level)	20	
Carydale East	22 W. Taylor Run Parkway	multi-story building needs elevated receptors	Residence Building (Multi level)	18	
Hunting Point	1202 South Washington Street	multi-story building needs elevated receptors	Residence Building (Multi level)	8	
Marina Towers	501 Slaters Lane	multi-story building needs elevated receptors	Residence Building (Multi level)	14	283
Meridian Building	1200 First Street	investigate? Same vicinity as Braddock Place/Potomac Club Apts.	Residence Building (Multi level)	16	
Port Royal Condo	801 N. Pitt Street	multi-story building needs elevated receptors	Residence Building (Multi level)	17	208
Portals of Alexandria	601 Four Mile Road	multi-story building needs elevated receptors	Residence Building (Multi level)	14	
Portner House Condos	621 N. St. Asaph Road	Phase 1 location, multi-story building	Residence Building (Multi level)		
Potomac Club Appartments	1201 Braddock Place	multi-story building needs elevated receptors	Residence Building (Multi level)	3	
Station Square Condo	1423 Powhatan Street	multi-story building needs elevated receptors	Residence Building (Multi level)		
The Calvert Apartments	3110 Mount Vernon Avenue	multi-story building needs elevated receptors	Residence Building (Multi level)	15	
Torpedo Factory Condo	102 N. Union Street	multi-story building needs elevated receptors	Residence Building (Multi level)	6	
Blessed Sacrament School	1417 W. Braddock Street	private school	School		
Geo. Washington Middle School	1005 Mt. Vernon Avenue	public school, multi-story building	School		
Jefferson Houston Elem School	1501 Cameron Street	public school, multi-story building	School		
Maury School	600 Russell Road	public school, multi-story building	School		
Mount Vernon Elementary School	2600 Commonwealth Avenue	public school, multi-story building	School		
Old Town Montessori	115 S. Washington Street	private school, 2-story building	School		
St. Mary's School	400 Green Street	public school, multi-story building needs elevated receptors	School		
St. Rita School	3801 Russell Street	private school, multi-story building	School		
Ladrey Senior Building	300 Wythe Street	multi-story building needs elevated receptors	Senior Living		
Woodbine Convelesant and Nursing Center	2729 King Street	assisted living, 3-story building	Senior Living		
Alexandria Community Shelter	2355 Mill Road	multi-story building needs elevated receptors	Shelter		
Carpenters Shelter	930 N. Henry	homeless shelter	Shelter		
Charles Houston Recreational Center	901 Wythe Street	recreational facility	City Facility		

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Area of Interest	Physical Address	Comments	Use	# of Stories	# of Units
City Hall	301 King Street	multi-story building needs elevated receptors	City Facility		
Nannie J. Lee Center	1108 Jefferson Street	2-story City building	City Facility		
Angel Park	between E. Taylor Run Parkway and W. Taylor Run Parkway	park	City Park		
Chetworth Park	south of Chetworth Place	park	City Park		
Dangerfield Island	north of Slater's Lane, east of GW Parkway	5 locations at flagpole height (docks, restaurant, launching area, soccer field, race start buoy	City Park		
Founders Park	200-400 North Union Street	park	City Park		
Powhatan Park	north of Vernon St, east of Rt. 1	park	City Park		
Radisson Hotel	901 N. Fairfax Street	multi-story building needs elevated receptors	Hotel		
Shereton Hotel	801 N. St. Asaph Street	multi-story building needs elevated receptors	Hotel		
Canal Way	1100 block of N. Pitt Street	townhome complex	Attached Single Family Residences		44
Chetworth Place	700-800 blocks of Chetworth Place	townhome complex	Attached Single Family Residences		
Gorham Tract	700-800 blocks of Bernard Street	townhome complex	Attached Single Family Residences		
Hearthstone Mews	between 1100 blocks of N. Royal and N. Fairfax Streets	townhome complex	Attached Single Family Residences		25
Michigan Avenue	1300 block of Michigan Avenue	townhome complex	Attached Single Family Residences		
Old Town Gateway	900 block of Powhatan Street, west of N. Washington Street	townhome complex	Attached Single Family Residences		
Pitt Street Station	1200 block of N. Pitt Street	townhome complex	Attached Single Family Residences		
Portner's Landing	600 blocks of N. Pitt Street and Tivoli Passage Way	townhome complex	Attached Single Family Residences		65
Potomac Greens	North of Massey Lane, between Potomac Greens Drive and Hunting Creek Drive	townhome complex	Attached Single Family Residences		
Rivergate Place	100 block of Madison Place and Montgomery Place	townhome complex	Attached Single Family Residences		54
Tobacco Quay	500 blocks of N. Fairfax and N. Union Streets	townhome complex	Attached Single Family Residences		46
Virginia Village	north of Second Street, between 1100 block of Powhatan Street and 1100 block of Portner Road	townhome complex	Attached Single Family Residences		
Westover	1000,1100,1200 blocks of Colonial Avenue	townhome complex	Attached Single Family Residences		
Yates Gardens	800 block of S. Lee Street	townhome complex	Attached Single Family Residences		
Shad Row Condo	600 Pendleton Street	garden style appartment complex	Residence Building (Garden level)		20
Arbello Apartments	833 Bashford Lane	garden style appartments	Residence Building (Garden level)	3	
Caylor Gardens	1701 Commonwealth Avenue	garden style appartment complex	Residence Building (Garden level)		

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Area of Interest	Physical Address	Comments	Use	# of Stories	# of Units
Gunston Hall	915 South Washington Street	garden style appartment complex	Residence Building (Garden level)	3	
Harbor Terrace Condo	501 Bashford Lane	garden style appartment complex	Residence Building (Garden level)	3	33
Mason Hall Apartments	1420 West Abingdon Drive	garden style appartment complex	Residence Building (Garden level)	4	
Old Town Crescent Condo	828 Slatters Lane	garden style appartment complex	Residence Building (Garden level)	4	
Potomac Shores Condo	402 Bashford Lane	garden style appartment complex	Residence Building (Garden level)	3	48
Potowmack Crossing	1600 West Abingdon Drive	garden style appartment complex	Residence Building (Garden level)	3	
Giant Food Store	500 First Street	2-story building	Commercial Building		
Masonic Temple	101 Callahan Drive	multi-story building needs elevated receptors	Commercial Building		
National Media Center	815 Slaters Lane	multi-story building	Commercial Building		
Salvation Army Headquarters	615 Slater's Lane	multi-story building needs elevated receptors	Commercial Building		
St. Anthony's Day Care	319 First Street	day care, multi-story building	Commercial Building		
Trans Potomac Building	1199 North Fairfax	multi-story building needs elevated receptors	Commercial Building	10	
YMCA	420 E. Monroe Street	recreation facility, multi-story building	Commercial Building		